ATTACHMENT 8: QUALITY ASSURANCE

Demonstrate that appropriate and well-defined Quality Assurance and Quality Control (QA/QC) measures will be used in each task. The information-gained discussion and QA/QC plan in this section should be consistent and incorporated into the project work plan. QA/QC measures may include, but are not limited to the following:

- *Procedural assurances, such as review processes for quality of reports, data, and lab analyses*
- *An existing or proposed QA/QC plan for field sampling and lab analysis of water quality that ensures high accuracy and precision*
- *Personnel qualifications that may include professional registrations (such as a California Professional Geologist or Professional Engineer), certifications, and experience of persons performing and overseeing work to be performed*
- *Standardized methodologies to be used, such as construction standards, health and safety standards, laboratory analysis, or accepted soils classifications methods*
- *Standardized analyses, such as statistical tests or American Society for Testing and Materials and U.S. Environmental Protection Agency analytical methodologies*
- *Quality requirements of material or computational methods, such as use of specific grades of building materials or use of specific, tested, and established models (or software)*
- *Comparison and calibration of models with actual data to enhance accuracy of modeling results.*

Monitoring Well Construction

Monitoring well construction standards are covered under a number of State and Federal regulations. For the purposes of this discussion, we will rely on a document published by California EPA titled "Monitoring Well Design and Construction for Hydrogeologic Characterization: Guidance Manual for Groundwater Investigations (July 1995)." This document references USEPA construction standards (SW-846); ATSM (1990 and 1992); DWR Bulletin 74-90; Title 22, California Code of Regulations, Division 4.5, Chapter 14, Article 6 (Environmental Health Standards for Management of Hazardous Waste); Title 23, California Code of Regulations, Division 3, Chapter 15, Article 5 and Chapter 16, Article 4 (Regulations of the State Water Resources Control Board and Regional Water Quality Control Boards); and California Business and Professions Code, Division 3, Chapter 9. Construction specifications for the Monitoring Wells will be prepared by a Registered Civil Engineer (KRCD Chief Engineer) prior to being released for bid. Labor compliance issues are to be coordinated through a contracted third party. A diagram showing standard monitoring well construction is attached to this section.

Construction is currently anticipated to be a ground level vault with sufficient concrete around the borehole to withstand occasional passage by farm equipment. Witness posts will be of a flexible type that does not interfere with equipment movements. There will be a gap between vault wall and the well casing that will prevent well damage. The locations of the monitoring wells will be such that (1) they are located as much out of the way as possible (to allow for the use of planned telemetry equipment); (2) located outside of any planned flood flow utilization area (to prevent direct flow of water from the surface to the aquifer being studied; and (3) to provide as much security to the monitoring well and associated equipment as possible.

A sanitary seal will be installed as deep as practical to prevent ambient soil conditions from impacting the surrounding aquifer.

Ongoing maintenance of the monitoring well will be periodic (usually winter) inspections to insure that rainfall does not accumulate within the vault (a problem noted in other monitoring wells used by KRCD). A simple wet-dry vacuum is used to remove any accumulated water.

The well will also be manually checked for depth to groundwater levels using an electric wire sounder to verify data logger accuracy and CASGEM reporting (April and October).

Well Construction Oversight/Geologic Data Evaluation

A KRCD staff member will be present during drilling operations for observational purposes (photo documentation, other issues of note). Data collected would be included in the final project report.

Geologic information developed through the project is to be evaluated by a Registered Geologist/Certified Hydrogeologist. A member of the KRCD Board of Directors holds these credentials and has agreed to review the drilling data for this project.

Water Sampling

Water quality samples collected for use by the project/grower and by the KRCD in its role as a third-party for the Regional Board's General Order of Waste Discharge for the Tulare Lake Basin will be collected and analyzed in accordance with the Quality Assurance Project Plan (QAPP) document that has been approved by the Regional Board for the Southern San Joaquin Valley Water Quality Coalition (SSJVWQC). This document specifies how samples are collected, preserved, transported, holding times allowed between collection and analysis, and analyzed by the contracted laboratories. Each individual laboratory possesses an internal QA/QC document that insures that the equipment is maintained in good working order, that appropriate QA/QC controls are in place (method blanks, laboratory spikes, etc.) and that the technicians are appropriately trained for the tests involved. Each batch of tests is reviewed by the Laboratory Director and data is maintained at the lab for a period of 5 years after sampling. Analyses are done by Regional Board specified EPA or Standard Method (SM) testing procedures.

The QAPP document that is referenced here was originally developed for the surface water testing program run by the KRCD, but the basics of sample collection, handling, and analysis all apply to groundwater samples.

As the specific constituents for water quality testing have yet to be established beyond basic physical parameters (electrical conductivity, pH, temperature, dissolved oxygen (a measure of proper volume exchange from the aquifer prior to sample collection), a discussion of potential analytical methods cannot be made at this time. It is likely that some metals will be tested for (EPA 200.8), as well as Nitrate + Nitrite-N levels (EPA 353.2) will be included in the analysis. Pesticides could be included as well. The General Order being proposed is only in the Interested Party comment stage at this point, with Public Comment periods of the final draft regulations and Regional Board action scheduled for January-February 2013.

UC Davis Laboratory QAQC

UC Davis will be collecting and sampling soil and water samples for this project for the work conducted under Task 1, Root Zone Characterization, and Task 2, Upper Vadose Zone Characterization. UC Davis will utilize QAQC procedures and protocols based upon EPA and Standard Methods. These QAQC procedures have been described in detail in a variety of QAPP documents (e.g. XXXX). These QAPPs describe sample collection, preservation, transport and holding time criteria and specific laboratory QAQC (e.g. spikes, standards, blanks, reps, detection limits, duplicates, etc.) used in the analyses of water and soil samples. The QAQC also entails long-term monitoring of QA performance where certified standards are used to assure analytical procedures and outcomes are within acceptable QAQC established guidelines. These documents can be provided if requested. A summary of the methods is shown in Table XX.

Table XX. Summary of methods and references to be used in the in the UC Davis Laboratory QAQC plan. Details available on request.

Water Samples, Dissolved Constituents		
Parameter	**Method tool**	**Original method refs**
TDN	Shimadzu TOC VCNS high temp combustion	Merriam et al., 1996
TDN	Persulfate Oxidation/colorimetry	Nydahl 1978; D'Elia et al. 1977; Koroleff 1983; Cabrera and Beare 1993
Nitrate	colorimetric	Doane and Horwath 2003
Ammonium	colorimetric	Verdouw et al. 1977
sulfate and chloride	ion chromatography	USEPA method 300.0
(bi)carbonate	titration	*Standard Method,* Method 2320
Major cations & anions	ICP or AES	USEPA methods 200.7 (Ca and Mg), 258.1 (K), and 273.1 (Na)

Tetra Tech Modeling QAQC

For the 1-D model we will use both analytical and numerical codes. We planned to use existing, well-respected models that have previously been used for unsaturated zone modeling. The models are: 1) the 1-D analytical solution of the advection-dispersion equation for solute transport (Cleary and Ungs, 1978) and 2) the numerical code, HYDRUS-1D (Šimůnek et al, 2005). In general, QA for models involves documentation of the equations and input values, description of assumptions used in the models and their appropriateness for the site conditions, a defined calibration and validation process, sensitivity analyses, clear presentation of results, and explanation of any unusual or atypical behavior or predicted valves.

The analytical solution of the advection-dispersion equation for solute transport (Cleary and Ungs, 1978) assumes that the soil physical parameters are constant. However, the initial distribution of nitrates and salts can vary with depth and the nitrate and salt concentration entering the soil column may vary with time. A range of water flux rates will be used to represent different recharge scenarios to provide quick solutions that can be run in a Monte Carlo framework to show the variability in nitrate flux to the groundwater under varying conditions. The model will be set-up for specific recharge rates where nitrate flux at a depth of 5 feet and nitrate concentration data in the vadose zone are available and the depth to groundwater is known to compare with the model predicted values. The nitrate flux rate will be compared to other estimates of nitrate flux to the groundwater based on agronomic practices.

The numerical code, HYDRUS-1D was developed jointly by Rien van Genuchten at the U.S. Salinity Laboratory of the USDA, Agricultural Research Service and by Jirka Šimůnek from the Dep. of Environmental Sciences at the University of California, Riverside (Šimůnek et al, 2005). HYDRUS-1D will be used to determine if the simpler analytical solutions can correctly simulate the flood flow and irrigation recharge conditions and nitrate fluxes to the groundwater. The QA process for the numerical model will include checks on the stability of the numerical solution when using the laboratory results for hydraulic conductivity properties, assignment of realistic boundary conditions for the cases to be simulated, and proper functioning of the algorithms. The water and mass balances will be checked to be sure that the results are within reasonable limits.